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Odonata from Bahia Solano, Colombian Pacific Region

Fredy Palacino-Rodríguez[1,2], Diego Andrés Palacino-Penagos[2], Albert Antonio González-Neitha[3]

1 Grupo de Investigación en Biología (GRIB), Departamento de Biología, Universidad El Bosque Av. Cra. 9 No. 131A-02, Bogotá, Colombia. **2** Grupo de Investigación en Odonatos y otros artrópodos de Colombia (GINOCO), Centro de Investigación en Acarología, Cl. 152B #55-45, Bogotá, Colombia. **3** Nidales S.A., Cra. 101 #150a-60, Bogotá, Colombia.
Corresponding author: Fredy Palacino-Rodríguez, odonata17@hotmail.com

Abstract
We present a checklist of Odonata species from Bahia Solano Municipality in the Pacific Region of Colombia. Sampling effort included 715 h between December 2018 and January 2020. We recorded 51 species in 27 genera and seven families. The most representative families were Libellulidae with 14 genera and 29 species and Coenagrionidae with 10 genera and 16 species. *Argia fulgida* Navás, 1934 and *Erythrodiplax funerea* (Hagen, 1861) are newly recorded from Chocó Department. The richer localities in terms of species numbers are conservation areas which are little impacted by indigenous traditional agriculture.

Keywords
Anisoptera, damselflies, dragonflies, Neotropical region, tropical rainforest, very wet tropical forest, Zygoptera

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Introduction

Colombia is one of the most biodiverse countries in the world based on its large numbers of vertebrates and vascular plants (Rangel 2005). This is due to the diversity of climates generated by altitudinal gradients, which produce a variety of ecosystems with high levels of biodiversity (Bernal et al. 2015). These conditions create natural geographic regions in the country, such as Insular, Caribbean, Andean, Orinoquia, Amazonia, and Pacific regions (Hernández-Camacho et al. 1992; Londoño et al. 2014). The Pacific Region is one of the most biodiverse ecoregions in the world because of its numerous forests and freshwater ecosystems, which include mangroves, estuarine forests, lowlands, and montane rainforests (Gómez et al. 2014). The region houses more than 7000 species of plants (e.g., Gentry 1986), 1500 species of birds (e.g., Gómez et al. 2014), and 700 species of butterflies (e.g., Andrade et al. 2007; Vargas and Salazar 2014), with many species endemic to the Pacific Region.

Exploration of Colombian odonates has flourished since 2000 (Palacino-Rodríguez 2016). More than 437 species of odonates have been recorded from Colombia (Bota-Sierra et al. 2018a, 2018b). However, knowledge of the local distribution of the species still requires much study. For example, based in the amount of publications including Colombian and Neotropical Odonata (e.g., Garrison et al. 2006, 2010), the odonate fauna of the Pacific Region is one of the most understudied regions in Colombia. This region has few formal studies on insects in general, and the odonates are just now being investigated. In the central zone of the Pacific Region, 38 species in

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11 families were listed by Pérez-Gutiérrez et al. (2007). Other studies (Bota-Sierra and Novelo-Gutiérrez 2017; Bota-Sierra et al. 2018a), especially in the central and southern zones of the Pacific Region, have recorded 73 species in 12 families, with 17 newly recorded species from the country. More recently, Bota-Sierra et al. (2019) recorded around 60 species from Chocó Department. In totality, about 90 species have been recorded for some localities from Chocó Department (Pérez-Gutiérrez and Palacino-Rodríguez 2011; Bota-Sierra et al. 2019). Because Bahía Solano municipality is located between the Pacific Ocean and the Serranía del Baudó, it has most of the Chocó department's ecosystems (EOT 2005). Although a high animal diversity, including Odonata, can be expected in Bahía Solano municipality, it has been poorly studied. Considering the lack of data, we documented species of dragonflies and damselflies for the first time in streams and ponds from Bahia Solano Municipality in western Chocó department. The objective of our study is to present a checklist of Odonata from this municipality. Behavioral observations are included for several species.

Methods

Study area. Bahia Solano Municipality (Fig. 1) is located at 05°10′N, 076°41′W (geographic coordinates of the Principal Park) and has an average altitude of 150 m a.s.l. The climate is excessively humid, with an annual precipitation of 4,850 mm. February and March are the drier months. The average temperature is 27 °C. According to the Holdridge's (1967) system, the life zones in this region correspond to very wet tropical forest and tropical rainforest (IGAC 1977). These ecosystems can harbor more than 200 species of plants per hectare on carbon-rich soils, including a high variety of palms, native trees, shrubs, lianas, grasses, and epiphytic vegetation (Faber-Langendoen and Gentry 1991). The predominant relief of the zone has high and moderate slopes. The soils have parental material constituted by diabases and basalts, which by the action of leaching rain has produced alterites and clays (IGAC 2011). Specimens were collected in several sites (Table 1).

Data collection. The map was constructed using ArcGIS 10.6. Three people spent a total of 714 h of fieldwork (65 h at each locality from 9:00 a.m. to 4:00 p.m. on 6 and 18 December 2018, 10–23 December 2019, and 13–19 January 2020 using an aerial entomological net. The sampling effort was not standardized in the different localities (Fig. 2); however, several individuals were captured only and then they were released after identified. Thus, several records in this study do not have voucher specimens. For comments on species identification, wing venation terminology follows Riek and Kukalová-Peck (1984). The classification system follows that outlined by Dijkstra et al. (2013, 2014). The identification at the genus level was corroborated based on Garrison et al. (2006, 2010); for species-level identifications, revisions and original descriptions were used. Comments on species identifications and natural history remarks resulting

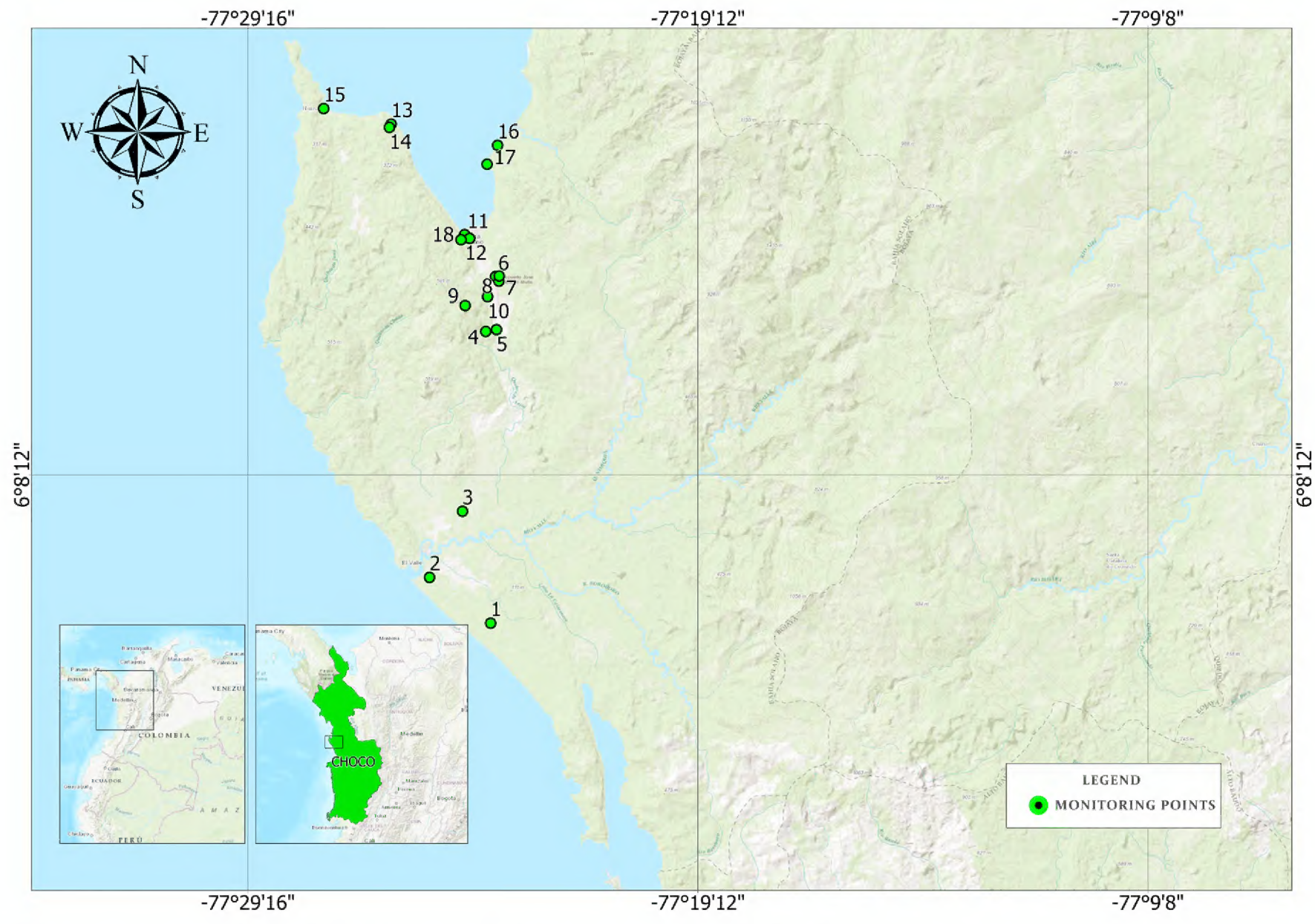

Figure 1. Sampling sites in Bahia Solano Municipality. Site numbers correspond to data presented in Table 1.

Table 1. Sites visited in Bahia Solano. The site number correspond to numbers on the map (Fig. 1).

Name	Site no.	Geographic coordinates	Altitude a.s.l. (m)	Habitat description
Playa Larga via El Valle	1	06°05′55″N, 077°25′12″W	40	Mangrove swamp composed of *Rhizophora mangle* L. and patches of *Cecropia peltata* L. Habitat exposed by the cutting of trees
Babillal via El Valle	2	06°04′55″N, 077°23′51″W	40	Unnamed pond used as a water source for cattle; ca 500 m of *Rhizophora mangle* L. patches. Dominant vegetation near to pond was *Ischaemum ciliare* Retz., *Mimosa pudica* L., *Heliconia psittacorum* L., and *Psidium guajava* L.
Toledo Reserve	3	06°07′23″N, 077°24′28″W	5	Toledo stream surrounded by forests of *Psidium guajava* L. and *Cecropia peltata* L. and dispersed patches of *Cocos nucifera* L., *Musa paradisiaca* L., *Theobroma cacao* L., *Citrus limon* L., *Montrichardia arborescens* Schott, *Vanilla* spp., *Carica papaya* L., *Artocarpus altilis* (Parkinson) Fosberg, and *Ischaemum ciliare* Retz. A protected area, used for indigenous agriculture
Jump of Quebrada Seca	4	06°11′26″N, 077°23′42″W	60	Near Quebrada Seca stream. Vegetation composed of numerous patches of *Cecropia peltata* L., *Mimosa pudica* L., and *Psidium guajava* L. Stream habitats with slow current; used for swimming
	5	06°11′23″N, 077°23′57″W	60	
Jump of Chocolatal stream	6	06°12′09″N, 077°23′54″W	40	Chocolatal stream. Dominant vegetation was *Cecropia peltata* L. with several patches of *Inga edulis* Mart., *Theobroma bicolor* Humb. & Bonpl., *Guadua angustifolia* Kunth, *Gliricidia sepium* (Jacq.) Kunth, and *Ischaemum ciliare* Retz. Stream habitats with slow current; used for fishing
	7	06°11′57″N, 077°24′23″W	40	
	8	06°12′29″N, 077°23′50″W	40	
	9	06°12′36″N, 077°23′43″W	40	
	10	06°12′32″N, 077°23′43″W	40	
Coca-Cola Beach	11	06°13′28″N, 077°24′19″W	40	Coca-Cola stream with slow current. Dominant vegetation was *Psidium guajava* L. and *Inga edulis* Mart., with patches of *Cocos nucifera* L., *Guadua angustifolia* Kunth, and *Gliricidia sepium* (Jacq.) Kunth. Isolated and with <10 people, who there fish crabs
	12	06°13′26″N, 077°24′29″W	40	
	18	06°13′33″N, 077°24′25″W	14	
Huina Beach	13	06°16′00″N, 077°26′03″W	60	Huina stream with slow velocity of the current. Vegetation was composed by a forest of *Cecropia peltata* L. with numerous patches of *Cocos nucifera* L., and some patches of *Psidium guajava* L., and *Guadua angustifolia* Kunth
	14	06°15′58″N, 077°26′04″W	60	
Mecana Beach	15	06°16′21″N, 077°27′34″W	40	Mecana stream. Patches of vegetation separated >200 m; composed of *Cecropia peltata* L., *Mimosa pudica* L., *Rhizophora mangle* L., *Inga edulis* Mart., and *Cocos nucifera* L. Tourists and local people pollute water and soil with garbage
Puddles near to Principal Park	16	06°15′06″N, 077°23′57″W	20	Puddles in front of Carolina del Mar Hotel, near Principal Park. Surrounded by small patches (2 m x 2 m) of *Mimosa pudica* L., *Psidium guajava* L., and *Colacasia esculenta* (L.) Schott
	17	06°15′49″N, 077°23′19″W	20	

from our fieldwork are given for some species. The collected specimens were deposited at the Hexapoda Collection of El Bosque University Museum of Sciences, Bogotá, Colombia (MCUB HE-Od 700-812).

Results

We recorded from Bahia Solano 51 species of Odonata, including 18 Zygoptera and 33 Anisoptera (Table 2) in 27 genera (11 Zygoptera and 16 Anisoptera) and seven families (four Zygoptera and two Anisoptera; one *incertae sedis* in Corduliidae *s.l.*). Libellulidae was the richest family with 14 genera and 29 species followed by Coenagrionidae with 10 genera and 16 species. The other species found belonged to the families Calopterygidae (two species), Heteragrionidae (one species), Perilestidae (one species), Aeshnidae (three species), and Corduliidae (one species). The highest diversity was found in El Valle (28 species), puddles near Principal Park (17 species), Mecana Beach (16 species), Babillal (a local name for a pond where common caiman live) near the airport (15 species), and Toledo Reserve (14 species; Table 2). Of the 51 species recorded, 42 species (82%) were reported from Toledo Reserve and El Valle, two protected areas which share only nine species. *Protoneura amatoria* Calvert, 1907 was exclusive to Toledo Reserve; *Neocordulia batesi batesi* (Selys, 1871), *Orthemis cultriformis* Calvert, 1899, *Uracis fastigiata* (Burmeister, 1839), and *Uracis imbuta* (Burmeister, 1839) were exclusive to El Valle. Among the recorded species, we found a new species of *Protoneura*, which is not described here. In addition, *A. fulgida* and *E. funerea* (Hagen, 1861) are newly recorded from Chocó Department. A list in alphabetic order of the Odonata species from Bahia Solano is provided in Table 2, and an annotated list in alphabetic order is presented below for some of the species including the two species, *A. fulgida* and *E. funerea*, newly recorded from Chocó Department.

Zygoptera
Perilestidae

Perissolestes remotus (Williamson & Williamson, 1924)

Material studied. COLOMBIA • 1 ♂; Chocó, municipality of Bahia Solano, Toledo Reserve; 06°07′23″N, 077°24′28″W; 5 m a.s.l.; 14 Dec. 2018 (not collected) • 1 ♂; same data but 11 Dec. 2019 (not collected) • 1 ♂; same data but Jump of Chocolatal stream; 06°12′09″N, 077° 23′54″W; 40 m a.s.l.; 13 Dec. 2018 (not collected) • 1 ♂; same data but 13 Dec. 2019 (not collected).

Identification. Males have a small tubercle projected beyond the apex of S10 representing the anal plate, spine on cercus basal to mid-length of the appendage and caudally directed (Williamson and Williamson 1924).

Remarks. This species was found inhabiting small lowland rainforest sandy streams, near trees.

Calopterygidae

Hetaerina caja caja (Drury, 1773)

Material examined. COLOMBIA. • 1 ♂, 1 ♀; Chocó, municipality of Bahia Solano, Toledo Reserve; 06°07′ 23″N, 077°24′28″W; 5 m a.s.l.; 14 Dec. 2018; D. Palacino, A. González, F. Palacino-Rodríguez leg.; MCUB

Table 2. Odonata species by site. A = puddles near Principal Park, B = Mecana Beach, C = Toledo Reserve, D = Coca-Cola Beach, E = Huina Beach, F = Quebrada Seca stream, G = Chocolatal stream, H = Babillal near the airport, I = El Valle, and J = Babillal between El Valle and Bahia Solano Municipality.

	Locality									
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**
Family Calopterygidae										
Hetaerina caja caja (Drury, 1773)			X	X		X	X			
Hetaerina fuscoguttata Selys, 1878			X	X		X	X			
Family Coenagrionidae										
Argia adamsi Calvert, 1902			X					X	X	
Argia fulgida Navás, 1934							X			
Argia indicatrix Calvert, 1902		X	X					X	X	
Argia pulla Hagen in Selys, 1865		X	X						X	
Argia translata Hagen in Selys, 1865			X						X	
Dactylobasis demarmelsi Pérez-Gutiérrrez, 2019									X	
Ischnura capreolus (Hagen, 1861)	X									
Ischnura hastata (Say, 1840)										X
Leptobasis vacillans Hagen in Selys, 1877	X								X	
Mecistogaster linearis infumata Fraser, 1946									X	
Megaloprepus coerulatus (Drury, 1782)			X				X		X	
Protoneura amatoria Calvert, 1907			X							
Protoneura sp. nov.							X			
Psaironeura angeloi Tennessen, 2016		X					X			
Family Heteragrionidae										
Heteragrion erythrogastrum Selys, 1886				X			X			
Family Perilestidae										
Perissolestes remotus (Williamson & Williamson, 1924)			X				X		X	
Family Aeshnidae										
Gynacantha membranalis Karsch, 1891	X	X				X				
Gynacantha mexicana Selys, 1868	X					X				
Gynacantha nervosa Rambur, 1842	X	X				X				
Incertae sedis										
Neocordulia batesi (Selys, 1871)									X	
Family Libelluidae										
Anatya guttata (Erichson, 1848)		X			X				X	
Cannaphila mortoni Donnelly, 1992	X				X				X	
Dythemis nigra Martin, 1897			X				X	X	X	X
Dythemis sterilis sterilis Hagen, 1861			X				X			
Elasmothemis cannacrioides (Calvert, 1906)	X					X				
Erythemis credula (Hagen, 1861)					X			X	X	
Erythemis haematogastra (Burmeister, 1839)	X	X						X		
Erythemis mithroides (Brauer, 1900)					X			X		
Erythemis peruviana (Rambur, 1842)		X			X			X	X	
Erythemis vesiculosa (Fabricius, 1775)	X	X			X			X	X	
Erythrodiplax andagoya Borror, 1942	X							X		
Erythrodiplax basalis (Kirby, 1897)								X		X
Erythrodiplax fervida (Erichson, 1848)			X						X	
Erythrodiplax funerea (Hagen, 1861)										X
Erythrodiplax fusca (Rambur, 1842)	X	X						X	X	X
Erythrodiplax kimminsi Borror, 1942		X						X	X	X
Erythrodiplax umbrata (Linnaeus, 1758)	X	X			X				X	X
Idiataphe longipes (Hagen, 1861)								X	X	
Libellula herculea Karsch, 1889			X						X	
Miathyria marcella (Selys in Sagra 1857)		X			X				X	
Orthemis cultriformis Calvert, 1899									X	
Orthemis discolor (Burmeister, 1839)	X	X			X			X	X	
Pantala flavescens (Fabricius, 1798)	X	X			X	X		X	X	
Pantala hymenaea (Say, 1840)	X					X				
Perithemis lais (Perty, 1834)			X				X			
Tramea calverti Muttkowski, 1910	X				X	X				
Tramea binotata (Rambur, 1842)	X	X				X				
Uracis fastigiata (Burmeister, 1839)									X	
Uracis imbuta (Burmeister, 1839)									X	
Total of species	**17**	**16**	**14**	**3**	**11**	**10**	**11**	**15**	**28**	**7**

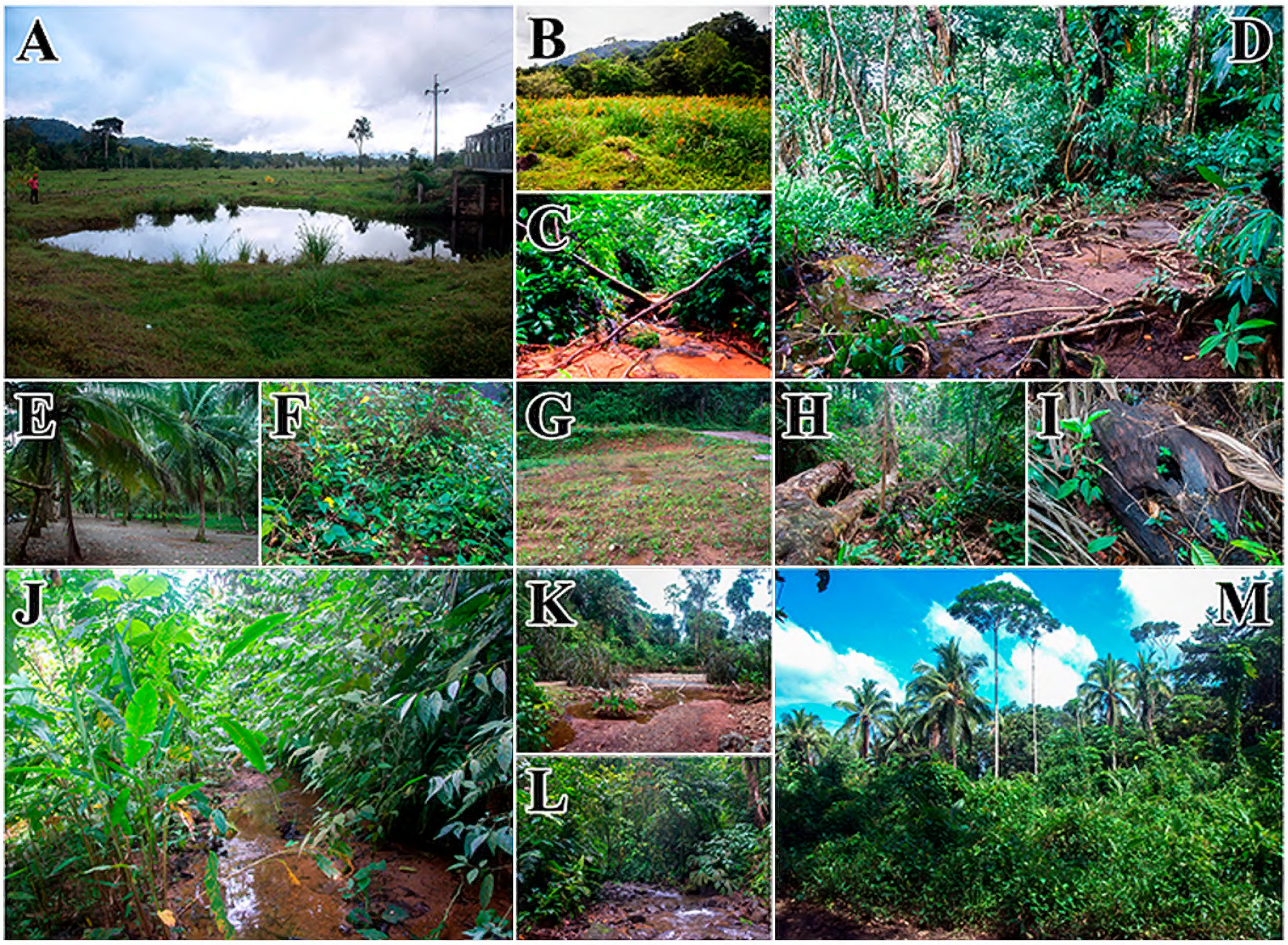

Figure 2. Bahia Solano habitats. **A**. Babillal via El Valle, **B**. Babillal near the airport, **C**. Coca-Cola Beach, **D**. Huina Beach, **E**. Mecana Beach, **F**. *L. vacillans* habitat near Principal Park, **G**. Puddles near Principal Park, **H**. Playa Larga, **I**. *M. coerulatus* habitat at Playa Larga, **J, K**. Quebrada Seca, **L**. Toledo Reserve, and **M**. El Valle.

HE-Od 704, 705. • 1 ♂; same data but Coca-Cola Beach, 06°13′28″N, 077°24′19″W; 40 m a.s.l.; 12 Dec. 2018; D. Palacino, A. González, F. Palacino-Rodríguez leg.; MCUB HE-Od 706. • 1 ♂; same data but Jump of Quebrada Seca; 06°11′26″N, 077°23′42″W; 60 m a.s.l.; 10 Dec. 2018; D. Palacino, A. González, F. Palacino-Rodríguez leg.; MCUB HE-Od 707. • 1 ♂; same data but Jump of Chocolatal stream; 06°11′57″N, 077°24′23″W; 40 m a.s.l.; 09 Dec. 2018; D. Palacino, A. González, F. Palacino-Rodríguez leg.; MCUB HE-Od 708. • 1 ♂, 1 ♀; same data but, Toledo Reserve; 06°07′23″N, 077°24′28″W; 5 m a.s.l.; 16 Dec. 2019 (not collected). • 2 ♂, 1 ♀; same data but 10 Dec. 2019 (not collected). • 3 ♂; same data but Coca-Cola Beach, 06°13′28″N, 077°24′19″W; 40 m a.s.l.; 18 Dec. 2019; D. Palacino, A. González, F. Palacino-Rodríguez leg.; MCUB HE-Od 706.

Identification. Postoccipital tubercles small or absent; median lobe in cerci that in the mediodorsal view shows a cleft forming two smaller lobes: the anterior one is gently curved, whereas the posterior one forms an acute point (Garrison 1990).

Remarks. We saw high variability in the size of the lobes on cerci, but postoccipital tubercles were always present and small.

***Hetaerina fuscoguttata* Selys, 1878**
Figure 3A

Material examined. COLOMBIA. • 2 ♂; Chocó, municipality of Bahia Solano, Toledo Reserve; 06°07′23″N, 077°24′28″W; 5 m a.s.l.; 14 Dec. 2018; D. Palacino, A. González, F. Palacino-Rodríguez leg.; MCUB HE-Od 709, 710. • 2 ♂; same data but, Coca-Cola Beach; 06°13′28″N, 077°24′19″W; 40 m a.s.l.; 12-xii-2018; D. Palacino, A. González, F. Palacino-Rodríguez leg.; MCUB HE-Od 711, 712. • 4 ♂; 1 ♂; same data but 12 Dec. 2019 (not collected). • 1 ♂; same data but, Jump of Quebrada Seca; 06°11′26″N, 077°23′42″W; 60 m a.s.l.; 10 Dec. 2018; D. Palacino, A. González, F. Palacino-Rodríguez leg.; MCUB HE-Od 713. • 1 ♂; same data but, Jump of Chocolatal stream; 06°11′57″N 077°24′23″W; 40 m a.s.l.; 09 Dec. 2018; D. Palacino, A. González, F. Palacino-Rodríguez leg.; MCUB HE-Od 714.

Identification. Brown spots on wingtips; the superior tooth, anterior to the transverse ridge, forms a low diagonally oriented mound. Some specimens have the mound prominent, forming a supplementary transverse ridge on the median lobe, which was slightly bilobate (Garrison 1990).

Heteragrionidae

***Heteragrion erythrogastrum* Selys, 1886**
Figure 3B

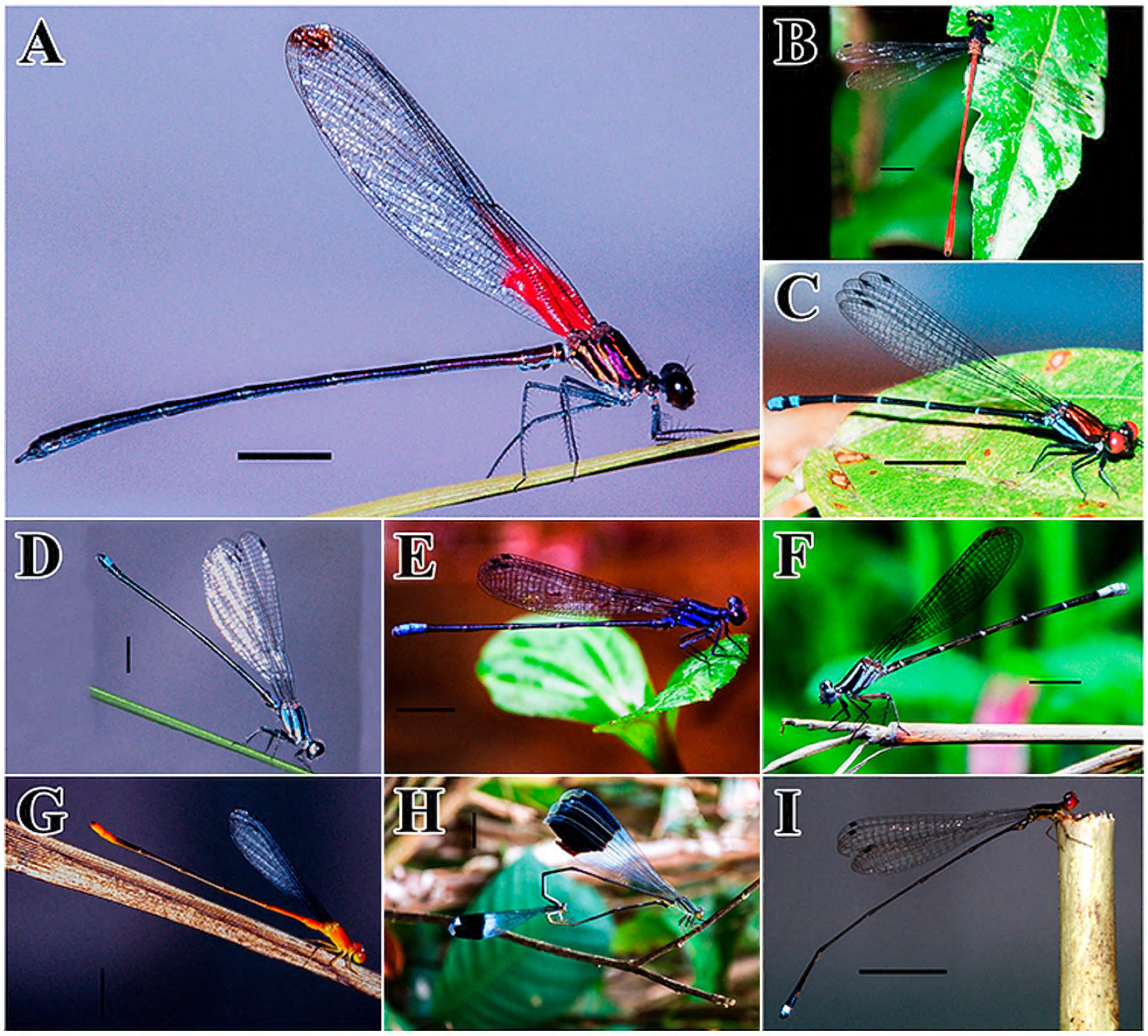

Figure 3. Zygoptera species from Bahia Solano. **A.** *Hetaerina fuscoguttata*. **B.** *Heteragrion erythrogastrum* **C.** *Argia fulgida*. **D.** *Argia indicatrix*. **E.** *Argia pulla* male. **F.** *Argia pulla* female. **G.** *Leptobasis vacillans* **H.** *Megaloprepus coerulatus*. **I.** *Psaironeura angeloi*. Scale bars = 1 cm.

Material examined. COLOMBIA. • 1 ♂; Chocó, municipality of Bahia Solano, Coca-Cola Beach; 06°13′26″N, 077°24′29″W; 40 m a.s.l.; 12 Dec. 2018; D. Palacino, A. González, F. Palacino-Rodríguez leg.; MCUB HE-Od 715; • 2 ♂; same data but 21 Dec. 2019 (not collected). • 1 ♂; same data but Jump of Chocolatal stream; 06°12′29″N, 077°23′50″W; 40 m a.s.l.; 09 Dec. 2018; D. Palacino, A. González, F. Palacino-Rodríguez leg.; MCUB HE-Od 716.

Identification. The abdomen is largely red, and the face is black. The thorax is brown, with shades darker on the dorsal region (Bota-Sierra and Novelo-Gutiérrez 2017).

Coenagrionidae

***Argia fulgida* Navás, 1934**

Figure 3C

New departmental record: COLOMBIA. • 1 ♂; Chocó, municipality of Bahia Solano, Jump of Chocolatal stream; 06°12′29″N, 077°23′50″W; 40 m a.s.l.; 09 Dec. 2018; D. Palacino, A. González, F. Palacino-Rodríguez leg.; MCUB HE-Od 700; • 1 ♂; same data but 15 Dec. 2018; MCUB HE-Od 701. • 1 ♂; same data but Jump of Chocolatal stream; 06°12′32″N, 077°23′43″W; 40 m a.s.l.; D. Palacino, A. González, F. Palacino-Rodríguez leg. 16 Dec. 2018; MCUB HE-Od 702. • 2 ♂; same data but Playa Larga-El Valle; 06°05′55″N, 077°25′12″W; 40 m a.s.l.; 13 Jan. 2020 (not collected).

Identification. Males have ventral and dorsal branches of the paraproct similar in length. Ental process of genital ligula absent. Females with mesostigmal lobe linear posteriorly and lacking posteriorly deflected margin (Garrison and von Ellenrieder 2018).

***Argia indicatrix* Calvert, 1902**

Figure 3D

Material examined. COLOMBIA. • 1 ♂; Chocó, municipality of Bahia Solano, Mecana Beach; 06°16′21″N, 077°27′34″W; 40 m a.s.l.; 08 Dec. 2018; D. Palacino, A. González, F. Palacino-Rodríguez leg.; MCUB HE-Od 717; • 7 ♂; same data but 12 Dec. 2019 (not collected).

• 3 ♂; same data but Toledo Reserve; 06°07′23″N, 077° 24′28″W; 5 m a.s.l.; 17 Dec. 2018; D. Palacino, A. González, F. Palacino-Rodríguez leg.; MCUB HE-Od 718-720. • 1 ♂; same data but Playa Larga-El Valle; 06° 05′55″N, 077°25′12″W; 40 m a.s.l.; 16 Dec. 2018; D. Palacino, A. González, F. Palacino-Rodríguez leg.; MCUB HE-Od 721; • 2 ♂; same data but 14 Dec. 2018; MCUB HE-Od 722, 723; • 2 ♂; same data but 18 Dec. 2019 (not collected). • 1 ♂; same data but Jump of Chocolatal stream; 06°12′32″N, 077°23′43″W; 40 m a.s.l.; 18 Jan. 2020 (not collected).

Identification. Male thorax blue and black. Pterothorax with narrow violaceous antehumeral stripe and humeral stripe broad and dark. S9 dorsally blue. Cercus with inner branch located more basally (0.50–0.70 of cercus) and represented by a single tooth, the outer branch longer than the inner branch. Cercus with hand shape and index finger pointed. Female mesostigmal lobe enlarged and broadly foliate, with a narrow, laminate, and digit-like lobe medially oriented (Garrison and von Ellenrieder 2015).

Argia pulla Hagen in Selys, 1865

Figure 3E, F

Material examined. COLOMBIA. • 4 ♂, 4 ♀; Chocó, municipality of Bahia Solano, Mecana Beach; 06°16′ 21″N, 077°27′34″W; 40 m a.s.l.; 08 Dec. 2018; D. Palacino, A. González, F. Palacino-Rodríguez leg.; MCUB HE-Od 724-731. • 4 ♂, 4 ♀; same data but Toledo Reserve; 06°07′23″N, 077°24′28″W; 5 m a.s.l.; 07 Dec. 2018; D. Palacino, A. González, F. Palacino-Rodríguez leg.; MCUB HE-Od 732-739; • 10 ♂, 2 ♀; same data but 15 Jan. 2020 (not collected). • 4 ♂, 2 ♀; same data but Playa Larga-El Valle; 06°05′55″N, 077°25′12″W; 40 m a.s.l.; 14 Dec. 2018; D. Palacino, A. González, F. Palacino-Rodríguez leg.; MCUB HE-Od 740-745.

Identification. Male cercus bifid with a smaller medial tooth, paraproct trilobed with two lobes digit-like. Female mesostigmal plate with a small, digit-like lobe extending medially and slightly notched externally in dorsal view (Garrison and von Ellenrieder 2015).

Remarks. This is an abundant species in the grassland near banana and cane crops.

Argia translata Hagen in Selys, 1865

Material examined. COLOMBIA. • 1 ♂; Chocó, municipality of Bahia Solano, Toledo Reserve; 06°07′23″N, 077° 24′28″W; 5 m a.s.l.; 07 Dec. 2018; D. Palacino, A. González, F. Palacino-Rodríguez leg.; MCUB HE-Od 746. • 1 ♂; same data but Playa Larga-El Valle; 06°05′ 55″N, 077°25′12″W; 40 m a.s.l.; 14 Dec. 2018; D. Palacino, A. González, F. Palacino-Rodríguez leg.; MCUB HE-Od 747; • 1 ♂; same data but 15 Jan. 2020 (not collected).

Identification. Males have dark body and cercus roundly quadrate and slightly bilobate distally, longer along inner margin and ending in a tooth. Females have mesepisternal tubercles that are posterolateral to mesostigmal plates. Mesostigmal plates are separated medially by a distance equal to 1.5 times the width of each lobe (Garrison and von Ellenrieder 2015).

Dactylobasis demarmelsi Pérez-Gutiérrez, 2019

Material examined. COLOMBIA. • 2 ♀; Chocó, municipality of Bahia Solano, Babillal via El Valle; 06°04′55″N, 077°23′51″W; 40 m a.s.l.; 14 Dec. 2018; D. Palacino, A. González, F. Palacino-Rodríguez leg.; MCUB HE-Od 811, 812.

Identification. Anterior lobe of pronotum inflated and pale yellow with dark brown anterior edge, pronotal hind lobe rounded, dark brown in middle and pale blue laterally. Mesanepisternum dark metallic green with a pair of horns cephalad oriented, convergent in dorsal view, and with tips curved towards dorsal carina (Pérez-Gutiérrez, 2019).

Remarks. Individuals were found in shrubs near marshes within riparian forest, in the same habitat from *Megaloprepus coerulatus* (Drury, 1782).

Ischnura capreolus (Hagen, 1861)

Material examined. COLOMBIA. • 1 ♂, 1 ♀; Chocó, municipality of Bahia Solano, puddles near Principal Park; 06°15′06″N, 077°23′57″W; 20 m a.s.l.; 18 Dec. 2018; D. Palacino, A. González, F. Palacino-Rodríguez leg.; MCUB HE-Od 748, 749; • 1 ♂, 1 ♀; same data but 06 Dec. 2018; MCUB HE-Od 750, 751; • 1 ♂, 1 ♀; same data but 16 Jan. 2020 (not collected).

Identification. Males with green face; eyes and postocular spots blue. Dorsal region on thorax, greenish-blue with black stripes, lateral region green. Dorsal region of abdomen metallic black with last segments light blue, ventral region olive green. Dorsum of S10 raised and deeply forked. Cercus entire and paraproct forked. Female has green face, thorax lime-green or blue with black stripes. Abdomen color similar to that of the male (Hagen 1861).

Remarks. We found this species in very small puddles (area ≤60 cm^2) less than 10 m from homes.

Ischnura hastata (Say, 1840)

Material examined. COLOMBIA. • 2 ♀; Chocó, municipality of Bahia Solano, Babillal via El Valle; 06° 04′55″N, 077°23′51″W; 40 m a.s.l.; 14 Dec. 2018; D. Palacino, A. González, F. Palacino-Rodríguez leg.; MCUB HE-Od 752, 753; • 1 ♀; same data but 23 Dec. 2019 (not collected).

Identification. Females with dull greenish eyes, with brown cap; thorax gray on upper sides and white on lower sides; abdomen pruinose gray (Say 1840).

Leptobasis vacillans Hagen in Selys, 1877

Figure 3G

Material examined. COLOMBIA. • 2 ♂; Chocó, municipality of Bahia Solano, puddles near Principal Park;

06°15′49″N, 077°23′19″W; 20 m a.s.l.; 06 Dec. 2018; D. Palacino, A. González, F. Palacino-Rodríguez leg.; MCUB HE-Od 754, 755. • 1 ♀; same data but Playa Larga-El Valle; 06°05′55″N, 077°25′12″W; 40 m a.s.l.; 14 Dec. 2018; D. Palacino, A. González, F. Palacino-Rodríguez leg.; MCUB HE-Od 756; • 2 ♂; same data but 16 Jan. 2020 (not collected).

Identification. Body yellowish-orange. Metafemur with inner row of acute and subequal spurs. Cercus as wide as long with posterior half bent ventrally into a triangular tooth. Female posterior lobe of prothorax raised, with middle portion much longer than lateral portion, and with lateral margin rounded and ventrally bent (Garrison and von Ellenrieder 2010).

Remarks. Males were found inside a network of thorny grass in the same habitat that *I. capreolus* but on a 1 m of scrap metal. Individuals showed inter- and conspecific aggression by biting each other's wings. One female was found in El Valle near a native forest.

***Mecistogaster linearis infumata* Fraser, 1946**

Material examined. COLOMBIA. • 1 ♂; Chocó, municipality of Bahia Solano, Playa Larga-El Valle; 06°05′55″N, 077°25′12″W; 40 m a.s.l.; 14 Dec. 2018 (not collected); • 1 ♂ same data but 14-xii-2019 (not collected).

Identification. Males and females with green head, thorax green with black stripes; abdomen with black dorsum and green venter. Spot on distal alar region white in males and yellow in females. Abdomen length: 110–112 mm (male) and 81–93 mm (female). Posterior wing length: 55 mm (male) and 52 mm (female) (Fraser 1946).

Remarks. This species was found in a conserved habitat near indigenous settlements, where it was perching at the edge of native forest, next to fallen trees.

***Megaloprepus coerulatus* (Drury, 1782)**
Figure 3H

Material examined. COLOMBIA. • 2 ♂, 2 ♀; Chocó, municipality of Bahia Solano, Playa Larga-El Valle; 06°05′55″N, 077°25′12″W; 40 m a.s.l.; 14 Dec. 2018; D. Palacino, A. González, F. Palacino-Rodríguez leg.; MCUB HE-Od 757-760; • 2 ♂, 1 ♀; same data but 21 Dec. 2019 (not collected).

Identification. Large-sized odonates (40–50 mm). Males and females with yellow head and thorax yellow with black stripes. Dorsal region of abdomen black, ventral region yellow. Wing with white spot followed by metallic dark blue spot to distal region. Females with black spot followed by white spot (Schultz and Fincke 2009; Palacino-Rodríguez et al. 2017).

Remarks. Specimens were found in protected areas, near holes in fallen trunks full of water. Six males and six females were simultaneously observed. One pair in tandem lasted 20 min. One female was observed flying around the male for 3 min. The specimens were observed inside of the native forest.

***Protoneura amatoria* Calvert, 1907**

Material examined. COLOMBIA. • 1 ♂; Chocó, municipality of Bahia Solano, Toledo Reserve; 06°07′23″N 077° 24′28″W; 5 m a.s.l.; 17 Dec. 2018 (No collected); • 1 ♂; same data but 18 Dec. 2019 (not collected).

Identification. Body red to orange with black stripes on thorax. Middorsal pterothoracic carina orange. Cercus shorter than S10 and half as long as paraproct. Cercus approximately quadrangular, as long as wide, with two mediodistal teeth, one apical and one subapical. Female with similar coloration pattern of males, but pale yellow instead of red to orange, dorsum of S1–S10 black. Triangular mesostigmal plate, with a central concavity and posteromedial corner adjacent to a mesepisternal horn, which is anteriorly oriented (von Ellenrieder and Garrison 2017).

***Psaironeura angeloi* Tennessen, 2016**
Figure 3I

Material examined. COLOMBIA. • 2 ♂, 2 ♀; Chocó, municipality of Bahia Solano, Mecana Beach; 06°16′21″N, 077°27′34″W; 40 m a.s.l.; 08 Dec. 2018; D. Palacino, A. González, F. Palacino-Rodríguez leg.; MCUB HE-Od 761-764; • 2 ♂, 1 ♀; same data but 20 Dec. 2019 (not collected). • 1 ♂; same data but Jump of Chocolatal stream; 06°12′29″N, 077°23′50″W; 40 m a.s.l.; 09 Dec. 2018; D. Palacino, A. González, F. Palacino-Rodríguez leg.; MCUB HE-Od 765.

Identification. Red eyes. Mesepisternum to humeral suture metallic green, mesinfraepisternum orange-brown, metainfraepisternum and ventral region of pterothorax yellow bronze. Dorsal region on S1 orange-brown with metallic green, S2 metallic green, S3–S7 orange-brown, S8 black with metallic green, S9 black with white spot covering the dorsal region. Triangular cerci, with big ventral lobe directed posteriorly. Dorsoapical projection with bent apex. Female with eyes and S7–S10 brown (Tennessen 2016).

Remarks. We found this species in the forest at an unnamed stream flowing to the Pacific Ocean.

Anisoptera
Incertae sedis (Corduliidae *s.l.*)

***Neocordulia batesi batesi* (Selys, 1871)**

Material examined. COLOMBIA. • 1 ♀; Chocó, municipality of Bahia Solano, Playa Larga-El Valle; 06°05′ 55″N, 077°25′12″W; 40 m a.s.l.; 14 Dec. 2018; D. Palacino, A. González, F. Palacino-Rodríguez leg.; MCUB HE-Od 766; • 1 ♂; same data but 19 Dec. 2019 (not collected).

Identification. Males with frons and vertex dark metallic blue; sternum of S8 without biconical protuberance; hamules with lateral ridges narrow, cerci with rather abrupt subapical swelling, hindwing of 35 mm. Females with abdomen shorter than hindwing; 13 or fewer postnodal cross-veins; vulvar lamina lobes with apicomedial

corners produced to truncate, posteriorly oriented tips; hindwing shorter than 39 mm (May 1992).

Remarks. This species was sympatric with *M. coerulatus* and *U. fastigiata*. We found *N. batesi* in a flooded native forest 20 m from a mangrove.

Libellulidae

Dythemis nigra Martin, 1897

Material examined. COLOMBIA. • 1 ♂; Chocó, municipality of Bahia Solano, Toledo Reserve; 06°07′23″N, 077°24′28″W; 5 m a.s.l.; 14 Dec. 2018 (not collected); • 3 ♂; same data but 16 Jan. 2020 (not collected). • 1 ♂; same data but Jump of Chocolatal stream; 06°12′32″N, 077°23′43″W; 40 m a.s.l.; 16 Dec. 2018 (not collected); • 1 ♂; same data but 15 Dec. 2018 (not collected); • 2 ♂; same data but 15 Dec. 2019 (not collected).

Identification. Blue eyes; metallic blue on frons extending to or just before frontoclypeal suture; pale spots on S7, oval and about half the length of the segment (Meurgey and Poiron 2011).

Dythemis sterilis sterilis Hagen, 1861

Figure 4A

Material examined. COLOMBIA. • 2 ♂; Chocó, municipality of Bahia Solano, Toledo Reserve; 06°07′23″N, 077°24′28″W; 5 m a.s.l.; 07 Dec. 2018; D. Palacino, A. González, F. Palacino-Rodríguez leg.; MCUB HE-Od 767, 768. • 1 ♂; same data but Jump of Chocolatal stream; 06°12′32″N, 077°23′43″W; 40 m a.s.l.; 16 Dec. 2018; D. Palacino, A. González, F. Palacino-Rodríguez leg.; MCUB HE-Od 769; • 2 ♂; same data but 14 Jan. 2020 (not collected).

Identification. Dorsal region on eyes of color red, lateral and ventral region yellow-brown, thorax brown with yellow spots, abdomen brown with black spots (Meurgey and Poiron 2011).

Remarks. Specimens in our study have the body darker, and the abdomen seems thicker than in individuals of elsewhere in Colombia. Wings are hyaline or infused. We found males in a native forest in Toledo Reserve, a protected area.

Elasmothemis cannacrioides (Calvert, 1906)

Figure 4B

Material examined. COLOMBIA. • 1 ♂; Chocó, municipality of Bahia Solano, Jump of Quebrada Seca; 06°11′26″N, 077°23′42″W; 60 m a.s.l.; 11 Dec. 2018; D. Palacino, A. González, F. Palacino-Rodríguez leg.; MCUB HE-Od 770. • 1 ♂; same data but puddles near Principal Park; 06°15′06″N, 077°23′57″W; 20 m a.s.l.; 18 Dec. 2018 (not collected); • 2 ♂; same data but 23 Dec. 2019 (not collected); • 1 ♂; same data but 17 Jan. 2020 (not collected).

Identification. Males with dorsal region of eyes red and lateral and ventral regions translucent. Thorax and S1–S3 brown-orange, and S4–S10 red; cercus black with red highlights (Calvert 1906; Palacino-Rodríguez et al. 2017).

Remarks. This species was found near houses.

Erythemis haematogastra (Burmeister, 1839)

Material examined. COLOMBIA. • 1 ♂; Chocó, municipality of Bahia Solano, puddles near Principal Park; 06°15′06″N, 077°23′57″W; 20 m a.s.l.; 18 Dec. 2018 (not collected). • 1 ♂; same data but Mecana Beach; 06°16′21″N, 077°27′34″W; 40 m a.s.l.; 08 Dec. 2018 (not collected), • 1 ♂; same data but Jump of Chocolatal stream; 06°12′32″N, 077°23′43″W; 40 m a.s.l.; 16 Dec. 2018 (not collected); • 1 ♂; same data but 22 Dec. 2019 (not collected).

Identification. Three to four robust spines on distal half of posterior femur; S1–S3 widened; head and thorax brown; abdomen red; brown spot on base of alar (Palacino-Rodríguez et al. 2014).

Erythemis vesiculosa (Fabricius, 1775)

Figure 4C

Material examined. COLOMBIA. • 1 ♂; Chocó, municipality of Bahia Solano, Chocó, municipality of Bahia Solano, Playa Larga-El Valle; 06°05′55″N, 077°25′12″W; 40 m a.s.l.; 16 Dec. 2018; D. Palacino, A. González, F. Palacino-Rodríguez leg.; MCUB HE-Od 771; • 4 ♂, 2 ♀; same data but 14 Dec. 2018 (not collected); • 2 ♂; same data but 21 Dec. 2019 (not collected); • 4 ♂; same data but 19 Jan. 2020 (not collected). • 1 ♂; same data but puddles near Principal Park; 06°15′06″N, 077°23′57″W; 20 m a.s.l.; 18 Dec. 2018 (not collected). • 1 ♂; same data but Mecana Beach; 06°16′21″N, 077°27′34″W; 40 m a.s.l.; 08 Dec. 2018 (not collected).

Identification. Three to four robust spines on distal half of posterior femur; S1–S3 widened; face and thorax green; abdomen green with black stripes (Palacino-Rodríguez et al. 2014).

Remarks. We found this species perching on wet sand 5 m from the sea. Individuals were perching and predating mosquitoes on marañón branches (*Syzygium malaccense*).

Erythrodiplax andagoya (Borror, 1942)

Figure 4D

Material examined. COLOMBIA. • 4 ♂; Chocó, municipality of Bahia Solano, puddles near Principal Park; 06°15′49″N, 077°23′19″W; 20 m a.s.l.; 06 Dec. 2018; D. Palacino, A. González, F. Palacino-Rodríguez leg.; MCUB HE-Od 772-775. • 10 ♂; same data but Playa Larga-El Valle; 06°05′55″N, 077°25′12″W; 40 m a.s.l.; 16 Dec. 2018; D. Palacino, A. González, F. Palacino-Rodríguez leg.; MCUB HE-Od 776-785; • 2 ♂; same data but 20 Dec. 2019 (not collected).

Identification. Frons black, with metalic blue reflections and lacking yellow lateral spots, whitish-blue pruinosity throughout body and cerci. Hw 22–24 mm with an opalescent band bordering basal spot. Terminal segment of vesica spermalis 1.6 mm or less. Vesica spermalis with

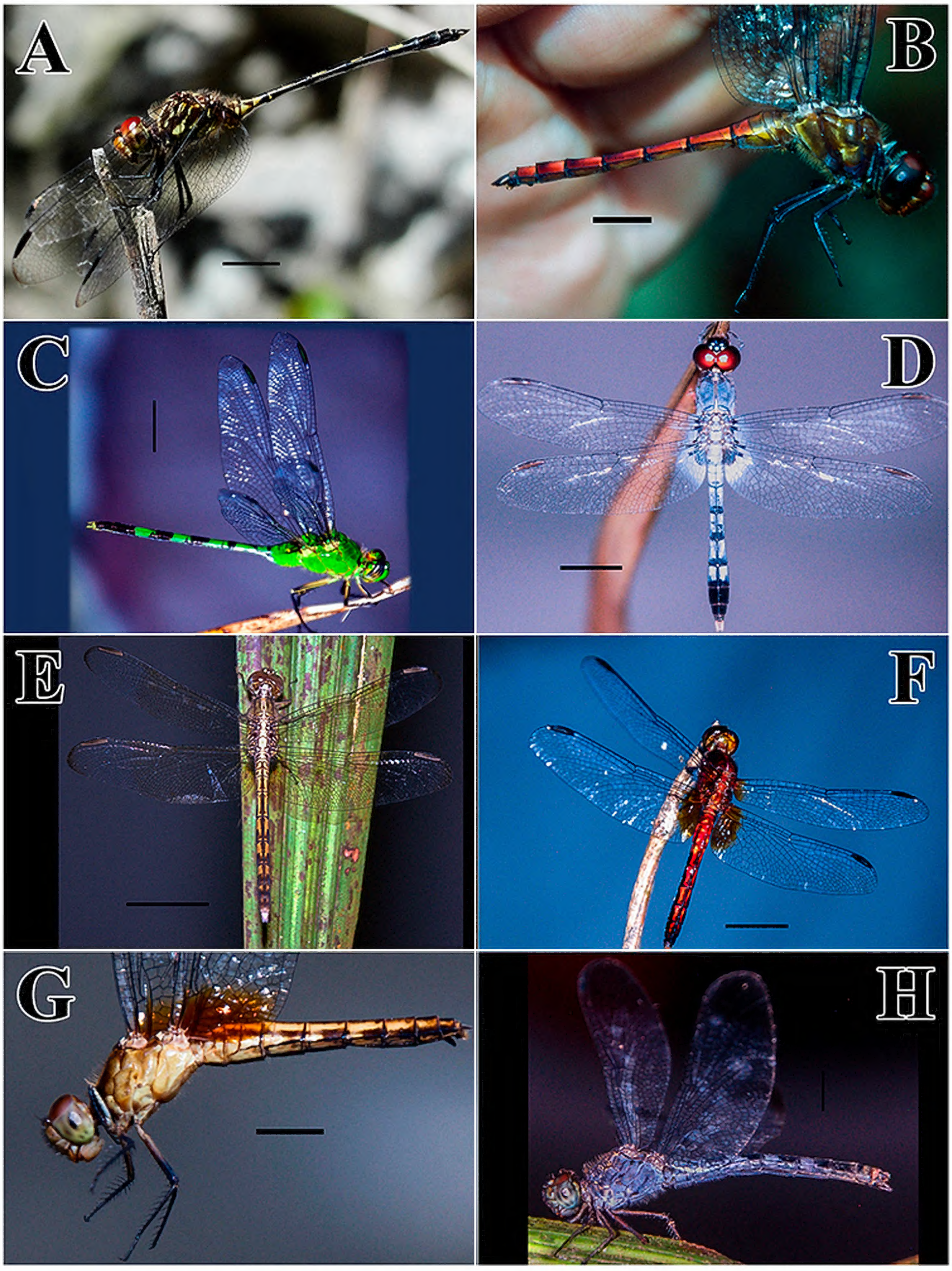

Figure 4. Anisoptera species from Bahia Solano. **A.** *Dythemis sterilis*. **B.** *Elasmothemis cannacrioides*. **C.** *Erythemis vesiculosa*. **D.** *Erythrodiplax andagoya*. **E.** *Erythrodiplax funerea*. **F.** *Erythrodiplax fusca* male. **G.** *Erythrodiplax fusca* female. **H.** *Uracis fastigiata*. Scale bars = 1 cm.

posterior lobe well-developed and median process not bilobed (Borror 1942).

Remarks. Individuals in our study showed high variation in the size of the vesica spermalis and body color. We found this species in swamps associated with cattle rising. Males have intraspecific fights and show interspecific aggression against males of *Erythrodiplax fusca*. Individuals perch at ~20 cm above the ground.

***Erythrodiplax funerea* (Hagen, 1861)**
Figure 4E

New departmental record. COLOMBIA. • 1 ♂ teneral; Chocó Department, Bahia Solano Municipality, Babilla habitat via El Valle; 06°04′55″N, 077°23′51″W; 40 m a.s.l.; 14 Dec. 2018; D. Palacino, A. González, F. Palacino-Rodríguez leg.; MCUB HE-Od 703.

Identification. Two cell rows between Rs and Rspl. Wings brown in females, or black from base of triangle to halfway between nodus and stigma in males. We confirmed the identification by examining the characters of the vesica spermalis, as given by Borror (1942).

Remarks. We found one teneral specimen that had a trace of future spots in all its wings. The specimen was found in a well inhabited by babillas.

***Erythrodiplax fusca* (Rambur, 1842)**
Figure 4F, G

Material examined. COLOMBIA. • 1 ♂, 1 ♀; Chocó, municipality of Bahia Solano, puddles near Principal Park; 06°15′49″N, 077°23′19″W; 20 m a.s.l.; 06 Dec. 2018; D. Palacino, A. González, F. Palacino-Rodríguez leg.; MCUB HE-Od 786, 787. • 1 ♀; same data but Mecana Beach; 06°16′21″N, 077°27′34″W; 40 m a.s.l.; 08 Dec. 2018; D. Palacino, A. González, F. Palacino-Rodríguez leg.; MCUB HE-Od 788. • 1 ♂, 4 ♀; same data but Playa Larga-El Valle; 06°05′55″N, 077°25′12″W; 40 m a.s.l.; 16 Dec. 2018; D. Palacino, A. González, F. Palacino-Rodríguez leg.; MCUB HE-Od 789-793; • 1 ♂, 1 ♀; same data but 14 Dec. 2018; MCUB HE-Od 794, 795; • 3 ♂, 1 ♀; same data but 19 Dec. 2019 (not collected). • 1 ♂, 1 ♀; same data but, Babillal via El Valle; 14 Dec. 2018; D. Palacino, A. González, F. Palacino-Rodríguez leg.; MCUB HE-Od 796, 797.

Identification. We corroborated the identification for this species using body color and vesica spermalis characters given by Borror (1942).

Remarks. This is the most abundant species in Bahia Solano Municipality. We counted more than 70 individuals simultaneously in an area of 100 m^2, in a well for cattle rising near the José Celestino Mutis Airport. Males are territorial, driving away to other satellites and territorial intraspecific males. Non-territorial males showed satellite behavior and perched on grass 10 m away from the well. Males catch females without courtship. Females were observed ovipositing for 5 min under the vigilance of the males. Males are besieged by males of *E. andagoya*.

***Libellula herculea* Karsch, 1889**

Material examined. COLOMBIA. • 1 ♂; Chocó, municipality of Bahia Solano, Toledo Reserve; 06°07′23″N, 077°24′28″W; 5 m a.s.l.; 17 Dec. 2018 (not collected). • 1 ♂; same data but Playa Larga-El Valle; 06°05′55″N, 077°25′12″W; 40 m a.s.l.; 14 Dec. 2018 (not collected).

Identification. Head and thorax brown; band of cream color running through medial region on thorax; abdomen robust and red. Female with brown abdomen, with a fold on each side of S8 (Karsch 1889; Palacino-Rodríguez et al. 2014).

***Orthemis cultriformis* Calvert, 1899**

Material examined. COLOMBIA. • 1 ♂; Chocó, municipality of Bahia Solano, Playa Larga-El Valle; 06°05′55″N, 077°25′12″W; 40 m a.s.l.; 14 Dec. 2018 (not collected). • 1 ♂; same data but 18 Dec. 2019 (not collected).

Identification. Metallic blue reflections on frons; thorax black with two yellow bands; lateral red stripes on abdomen, thinner from S3; abdomen in female yellow-orange and with lateral flanges in S8 (von Ellenrieder 2012).

Remarks. This species was sympatric with *M. coeruleatus*, *U. fastigiata*, and *N. batesi batesi*. *Orthemis cultriformis* was found in a flooded native forest 20 m from a mangrove.

***Uracis fastigiata* (Burmeister, 1839)**
Figure 4H

Material examined. COLOMBIA. • 1 ♀; Chocó, municipality of Bahia Solano, Playa Larga-El Valle; 06°05′55″N, 077°25′12″W; 40 m a.s.l.; 14 Dec. 2018; D. Palacino, A. González, F. Palacino-Rodríguez leg.; MCUB HE-Od 798; • 1 ♂; same data but 17 Dec. 2019 (not collected).

Identification. We identified this species following Costa and Santos (1997). Hw triangle crossed, Fw subtriangle with three or four cells, FW with five cubital cross-veins. Discoidal field in Hw with two rows of cells surpassing bifurcation RP_1-RP_2.

Remarks. The females that we found were gray.

Discussion

The 51 species recorded here represent about 12% of all species known to occur in Colombia. *Argia fulgida* was recorded from San José (Río Dagua, Valle del Cauca Department) and Ecuador localities by Garrison and von Ellenrieder (2017, 2018). Thus, our record was expected in Chocó. Likewise, the record of *Erythrodiplax funerea* was expected in Chocó, given their known distribution from Ecuador to North America (Paulson 2017).

The studied localities with the most species are conserved areas, El Valle and Toledo Reserve, which are little impacted by indigenous traditional agricultural activities. This supports the need to maintain the protected areas in order to maintain a high diversity of Odonata species (Bota-Sierra et al. 2018b). However, the core of deforestation areas in Colombia includes the Chocó littoral (IDEAM 2019), where more than 1200 species are threatened by the accelerated loss of forests and wetlands (Instituto Humboldt 2017). In our study, an example of habitat loss is the puddles near Principal Park (Fig. 2f, g), where we sampled 17 species. This habitat disappeared after sampling due to the construction of a hotel at this locality. The disappearance of these habitats is alarming

for all the species inhabiting in the area, especially *L. vacillans*, as this species was found only in two localities (Table 2), one of which disappeared.

Although the growth of human settlements will continue in Bahia Solano Municipality, habitats in rural areas of the municipality should be protected (PBOT 2019). *Dactylobasis demarmelsi*, *M. coerulatus*, *M. linearis infumata*, and *H. erythrogastrum* require specific habitats (Fincke 1992), which need adequate protection. We saw the structural diversity in vegetation typical of very wet tropical forest and tropical rainforest ecosystems, which could explain the high diversity of odonates in our study. Odonate diversity tends to be higher in less disturbed environments with multiple biotopes and varied microhabitats; such environments favor the coexistence of species with different ecophysiological requirements (De Marco et al. 2015; Oliveira-Júnior et al. 2017).

We were unable to collect any individuals of Gomphidae or Lestidae, but for some odonate families, sampling is less successful using conventional methods. Gomphids, for example, are difficult to see because they are strong flyers and often have secretive habits, which makes it difficult to see them in the field (Almeida et al. 2013). As suggested by Flint (1996) and Almeida et al. (2013), it will be necessary use complementary sampling methods to find all species and to better determine odonate diversity.

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Authors' Contributions

FP-R collected data and specimens in the field, contributed to the design of the study, identified the specimens, and wrote the manuscript. DAP, and AG collected data and specimens in the field, contributed to the design of the study, and wrote the manuscript.

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